Section O: Structures	Effective Date: 01-01-19 Revision #: 2

O 1 – FIBERGLASS MANHOLE/ SANITARY SEWER:	Effective Date: 01-01-19 Revision #: 2

SPECIFICATION:

Fiberglass manholes shall meet or exceed the performance specifications of:

- Shall be manufactured from commercial grade polyester resin or other suitable polyester or vinyl ester resins with fiberglass reinforcements specifically manufactured for use with sewage.
- Shall be a one-piece unit.
- Shall have no vertical seams.
- Shall meet ASTM Standards D 3753, Fiber-glass Reinforced Polyester Manholes and Wet Wells.
- Reinforcing material shall be Grade “E” type glass in the form of continuous roving and chop roving, having a coupling agent that will provide a suitable bond between the glass reinforcement and the resin.
- The inter surface shall be a resin-rich layer of 0.010 to 0.020 inches thick.
- The concentric cone section shall be affixed to the barrel section at the factory with resin-glass reinforced joint resulting in a one-piece unit.
- The manhole wall thickness shall not be less than 0.50 (1/2”) inches.
- Shall provide an area for which a grade ring or brick can be installed to accept a typical metal ring & cover and have strength to support a traffic load without damage to the manhole.
- As a UV inhibitor the resin on the exterior surface shall have a color pigment added for a minimum thickness of .125 inches.
- Stub out connections shall be made by using a fiberglass reinforced pipe stub out as a sealing surface for an approved manhole connection boot.
- Invert and bench area can be either a noncorrosive material completely enclosed in a minimum 1/4-inch layer of fiberglass chop or concrete coated with an approved coating.
- Shall have a minimum dynamic-load rating of 16,000 lbs. (AASHTO HS-20) when tested in accordance with ASTM D 3753 and shall not leak, crack or suffer other damage when load tested to 40,000 lbs.

SPECIFICATION (CONT.)

- Shall meet or exceed NBS PS 15-69 physical properties as listed in table 1, of that standard:
  - Ultimate Tensile Strength (psi) 15,000
  - Flexural Strength (psi) 22,000
  - Flexural Modulus or elasticity (psi) 1,000,000
- Shall have a concrete base, 8” thick when less than 12’ deep and 12” thick when more than 12’ deep.
- The base shall extend a minimum of 1 foot from the outside wall of the manhole.
- The base shall be sized to act as an anti-floatation device for the entire unit.
- Shall be sized per construction drawings.
- Affidavit of compliance to this specification shall be available upon request.

IDENTIFICATION:

Each manhole shall be marked inside and out with the following information:

- Manufactures name and trademark
- Manufactures factory location
- Manufactures serial number or date code
- Total length or nominal diameter

O 1 – CONTINUED:	**MANUFACTURER:** • CONTAINMENT SOLUTIONS, INC. • L.F. MANUFACTURING, INC. • OPEN
RESTRICTIONS:	

O 2 – FIBERGLASS MANHOLE LINER/ SANITARY SEWER:

Effective Date: 01-01-19
Revision #: 2

SPECIFICATION:

Fiberglass manhole liners shall meet or exceed the performance specifications of:

- Shall be manufactured from commercial grade polyester resin or other suitable polyester or vinyl ester resins with fiberglass reinforcements specifically manufactured for use with sewage.
- Shall be a one-piece unit.
- Shall have no vertical seams.
- Shall meet ASTM Standards D 3753, Fiber-glass Reinforced Polyester Manholes and Wet Wells.
- Reinforcing material shall be Grade “E” type glass in the form of continuous roving and chop roving, having a coupling agent that will provide a suitable bond between the glass reinforcement and the resin.
- The inter surface shall be a resin-rich layer of 0.010 to 0.020 inches thick.
- The concentric cone section shall be affixed to the barrel section at the factory with resin-glass reinforced joint resulting in a one-piece unit.
- The liner wall thickness shall not be less than 0.50 (1/2”) inches.
- Shall provide an area for which a grade ring or brick can be installed to accept a typical metal ring & cover and have strength to support a traffic load without damage to the manhole.
- As a UV inhibitor the resin on the exterior surface shall have a color pigment added for a minimum thickness of 0.125 inches.
- Shall have a minimum dynamic-load rating of 16,000 lbs. (AASHTO HS-20) when tested in accordance with ASTM D 3753 and shall not leak, crack or suffer other damage when load tested to 40,000 lbs.
- Shall meet or exceed NBS PS 15-69 physical properties as listed in table 1, of that standard:
  - Ultimate Tensile Strength (psi) 15,000
  - Flexural Strength (psi) 22,000
  - Flexural Modulus or elasticity (psi) 1,000,000
- Shall be sized per construction drawings.

RESTRICTIONS:

- Rehabilitation only.

SPECIFICATION (continued)

- Pipe entering through the manhole wall with an invert equal to or higher than the bench will be sealed all around the interior wall by use of a fiberglass patch kit. There will be no exposed mortar above bench or fillet level.
- Affidavit of compliance to this specification shall be available upon request.

IDENTIFICATION:

Each manhole liner shall be marked inside and out with the following information:

- Manufactures name and trademark
- Manufactures factory location
- Manufactures serial number or date code
- Total length or nominal diameter

MANUFACTURER:

- CONTAINMENT SOLUTIONS, INC.
- L.F. MANUFACTURING, INC.
- OPEN

O 3 – FIBERGLASS WETWELL LINER/ SANITARY SEWER:

Effective Date: 01-01-19
Revision #: 2

SPECIFICATION:

Fiberglass wet well liners shall meet or exceed the performance specifications of:

- Shall be manufactured from commercial grade polyester resin or other suitable polyester or vinylester resins with fiberglass reinforcements specifically manufactured for use with sewage.
- Shall be a one-piece unit.
- The wet good liner pipe shall have plain ends and have no vertical seams.
- Fiberglass tops and hatch openings shall be provided.
- Shall meet ASTM Standards D 3753, Fiber-glass Reinforced Polyester Manholes and Wet Wells.
- Reinforcing material shall be Grade “E” type glass in the form of continuous roving and chop roving, having a coupling agent that will provide a suitable bond between the glass reinforcement and the resin.
- The inter surface shall be a resin-rich layer of 0.010 to 0.020 inches thick.
- The liner wall thickness shall not be less than 0.625 (5/8”) inches.
- As a UV inhibitor the resin on the exterior surface shall have a color pigment added for a minimum thickness of 0.125 inches.
- Shall have a minimum dynamic-load rating of 16,000 lbs. (AASHTO HS-20) when tested in accordance with ASTM D 3753 and shall not leak, crack or suffer other damage when load tested to 40,000 lbs.
- Shall meet or exceed NBS PS 15-69 physical properties as listed in table 1, of that standard:
  - Ultimate Tensile Strength (psi) 15,000
  - Flexural Strength (psi) 22,000
  - Flexural Modulus or elasticity (psi) 1,000,000
- Shall be sized per construction drawings.

RESTRICTIONS:

- Diameters of 5’ or less.

SPECIFICATION (continued):

- Pipe entering through the wet well wall with an invert equal to or higher than the bench will be sealed all around the interior wall by use of a fiberglass patch kit.
- Affidavit of compliance to this specification shall be available upon request.

IDENTIFICATION:

Each wet well liner shall be marked inside and out with the following information:

- Manufactures name and trademark
- Manufactures factory location
- Manufactures serial number or date code
- Total length or nominal diameter

MANUFACTURER:

- CONTAINMENT SOLUTIONS, INC.
- L.F. MANUFACTURING, INC.
- OPEN

O 4 – MULTI-COMPONENT STRESS PANEL LINER SYSTEM/ SANITARY SEWER:

Effective Date: 01-01-19
Revision #: 2

SPECIFICATION:

Multi-layered poly resin composite protective manhole and wet well liner system shall meet or exceed the performance specifications of:

- Shall provide a waterproof, corrosion resistant liner to prevent any deterioration of concrete surfaces from hydrogen sulfide and other corrosive gases/acids produced by wastewater.
- Manufacture shall warrant material and workmanship for a minimum period of ten (10) years.
- Shall be a non load-bearing component.
- To ensure total unit responsibility, all material and installation shall be furnished by, and coordinated with, one supplier/ manufacturer.
- The interior surfaces to be protected shall include the walls, ceiling, benches and pipe entries.
- Total thickness of multi-component stress panel liner shall be a minimum of 500 mils and shall sustain a 300 PSI pull test.
- Use of this system is restricted to rehabilitation of existing structures.

PHYSICAL/ MATERIAL PROPERTIES:

1. Liner.

Installation	Liner
Moisture barrier	Modified Polymer
Surfacer	Polyurethane/Polymeric blend foam
Final corrosion barrier	Modified polymer

2. Modified polymer shall be sprayable, solvent free, two-component polymeric, moisture/chemical barrier specifically developed for the corrosive wastewater environment.

TYPICAL CHEMICAL ANALYSIS

"A" Component

Viscosity, 77° F, cps., ASTM D-1638	300-400
Physical State	Liquid
Color	Clear to amber
Hygroscopicity	Reacts with water

"B" Component

Viscosity, 160° F, cps., ASTM D-1638	400-600
Physical State	Liquid
Color	Flamingo Pink
Non-Volatile	100%

Reaction Profile (100 grams, 175° F sample)

Gel Time, seconds	1-2
Tack Free Time, seconds	15
Cure Time, seconds	30

Processing

A System / B System, volume ratio	1.00 / 1.00

RESTRICTIONS:

PHYSICAL/ MATERIAL PROPERTIES (continued):

Typical Physical Properties

Tensile Strength, PSI	>1500
Elongation, %	>125
Tear Strength, PSI	350
Shore D Hardness	55-65
100% Modulus, PSI	>1500

3. Polyurethane Rigid Structure Foam, low viscosity two-component, containing flame retardants.

TYPICAL CHEMICAL ANALYSIS

"A" Component

Viscosity, 77° F, cps., ASTM D-1638	200
Physical State	Liquid
Color	Dark Brown
Hygroscopicity	Reacts with water and evolves CO_2 gas

"B" Component

Viscosity, 77° F, cps., ASTM D-1638	600-1000
Physical State	Liquid
Color	Tan
Hygroscopicity	Absorbs water rapidly thus changing ratio

Reaction Profile (100 grams, 77° F sample)

Cream Time, seconds	1-4
Tack Free time, seconds	5-8
Rise Time, seconds	6-10

Processing

A System / B System, volume ratio	1.00 / 1.00

Typical Physical Properties

Density, nominal, core, lbs/ft3 ASTM D-1622 @ 74° F	4-10
Compression Strength, ASTM D-1621 @74° F parallel rise; PSI	90-150
Closed Cell Content, % - ASTM 1940 @ 74° F	Over 90
Shear Strength, PSI - ASTM C-273 @ 74° F	225-250

MANUFACTURER:

- CONCRETE CONSERVATION, INC.-
- SPECTRA-SHIELD
- OPEN

O 5 – POLYMORPHIC RESIN LINER SYSTEM / SANITARY SEWER:

Effective Date: 01-01-19
Revision #: 2

SPECIFICATION:

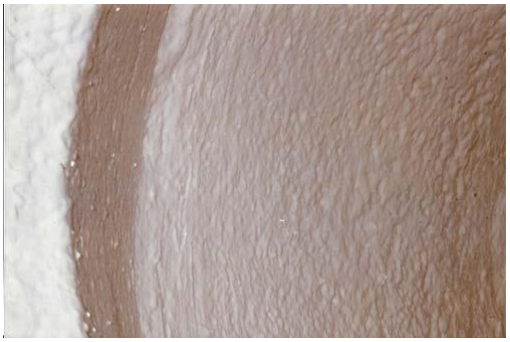
Polymorphic resin protective manhole and wet well liner system shall meet or exceed the performance specifications of:

- Manufacture shall warrant material and workmanship for a minimum period of ten (10) years.
- Shall be a modified ispthalic polyester liner system made of two-components, 100% solid, known as polymorphic resin as described below.
- Shall provide a waterproof, corrosion resistant liner to prevent any deterioration of concrete surfaces from hydrogen sulfide and other corrosive gases/acids produced by wastewater.
- Can be used to rehabilitate and protect concrete, steel, fiberglass, or masonry surfaces.
- System shall restore structural integrity of brick/concrete structures.
- Shall use an approved quick setting cementitious material to bring substrate to profile.
- To ensure total unit responsibility, all material and installation shall be furnished by, and coordinated with, one supplier/ manufacturer.
- The resin based material shall be used to form the sprayed on/structure enhanced monolithic liner covering all interior surfaces to be protected and shall include the walls, ceiling, benches, inverts and pipe entries.
- Application of liner system shall be in strict accordance with manufacture's recommendation.
- The three coat system is made of a prime coat (DS-101 10-25 mils thick), intermediate coat (DS301 75-150 mils thick), and a final coat (DS-401 10-25 mils thick). Final installation shall be a minimum thickness of 150 mils and not more than 250 mils thick.

RESTRICTIONS:

MINIMUM PHYSICAL/ MATERIAL PROPERTIES

Flexural Strength	ASTM D790	8,630 psi
Compressive Strength	ASTM D695	15,120 psi
Tensile Strength	ASTM D638	4,900 psi
Barcol Hardness	Impressor #L25	72-75
Adhesive Strength	Direct to Metal	1,582 psi
Adhesive Strength	Direct to Concrete	Substrate Failure



MANUFACTURER:

- ZEBRON 386
- OPEN

O 6 – PRECAST MANHOLES:

Effective Date: 01-01-19
Revision #: 2

SPECIFICATION:

- Precast manhole shall meet or exceed the performance specifications of ASTM C478 & C913 for round structures.
- Openings shall be manufactured per ASTM C76, coring shall be specified per plans.
- Structure to be watertight and resist buoyant force.
- Standard manhole precast riser sections shall not exceed 4-feet; larger pump station wet well sections may be approved.
- Concrete shall conform to:
  - Compressive strength 4,000 psi @ 28-days
  - Air content 4% min.
  - Aggregate: ASTM C33
  - Cementitious materials: minimum of 564 lbs./yd3.
  - Free of organic impurities.
- Manholes 4-feet deep or less shall have an eccentric cone or a flat top.
- Manholes over 4-feet deep shall have an eccentric cone.
- Manholes shall have a minimum inside diameter of 4-feet for sewer mains 12-inches and smaller.
- Manholes shall be 5-feet for sewer mains larger than 12-inches.
- 5-foot manholes shall have an 8” extended base.
- 4-foot manholes shall have a 6” extended base.
- Extended bases shall have a minimum thickness of 6-inches.
- Manholes at ground level and located in traffic areas shall have anti-inflow inserts per Section K.
- Lift and handling devices shall have safety factor of 4 or greater.
- Corrosion linings as specified and indicated on design drawings.

RESTRICTIONS:

SPECIFICATION (continued):

- Vents in remote or outfall areas shall be constructed of aluminum or 316 SST and shall extend a minimum of 2-feet above 100-year flood with integral non-corrosive insect screen.
- Vents in residential neighborhoods and commercial areas require special approval on a case-by-case basis.
- Watertight joints using ASTM C990 preformed flexible sealants.
- Pipe to manhole connections shall conform to ASTM C923 per Section H.
- Cylindrical wall seals per Section K.
- The location of the pipe connectors shall vary from the plans no more than ½-inch vertically and 5-degrees horizontally.

MANUFACTURES:

- OLD CASTLE
- TINDALL
- STAY-RIGHT
- CAPE FEAR PRECAST
- OPEN

O 6.1 – PRECAST WET WELL:

Effective Date: 01-01-19
Revision #: 2

SPECIFICATION:

Precast wet wells for pump stations shall meet or exceed the preceding performance specifications of precast manhole with supplemental requirements as indicated below:

- Concrete 5,000 psi compressive strength @ 28-days.
- Minimum wall thickness shall be 5” for 5’-0”, 6” for 6’-0” and 8” for 8’-0”.
- Provide 1-inch cover all reinforcing steel.
- Base section shall include a 1’-0” extended base unless otherwise specified.
- All fasteners, wedge anchors, bolts, and hooks shall be 316 stainless steel.
- Support grip for each float and dower cord shall be “Hubbell” closed mesh series 024-17-xxx.
- Raintight aluminum hatch per design drawings, lockable with matching eye and padlock per Section I.
- Top shall be set as minimum of 2’ above 100-year flood EL.
- Subject to leakage testing requirements per specifications.

RESTRICTIONS:

- **MANUFACTURES:**
- OLD CASTLE
- TINDALL
- STAY-RIGHT
- CAPE FEAR PRECAST
- OPEN

O 6.2 – PRECAST VAULTS:

Effective Date: 01-01-19
Revision #: 2

SPECIFICATION:

Precast concrete valve vaults shall meet or exceed the preceding requirements for precast manholes and with supplement requirements as indicated below:

- Conform to ASTM C913 & C890 for rectangular/square structures.
- Minimum 4’ x 4’ x 4’ with a minimum base thickness of 6” and minimum wall thickness of 5”.
- Live load rating of AASHTO HS20-44.
- Access hatches shall be paid lockable frame and cover, with a ¼” watertight aluminum plate and 1/8” thick x 3” wide 316 stainless steel hinges per Section I.
- Step to be installed 18” below hatch on a non-hinged side.
- Shall be watertight structure. Subject to leakage testing requirements per specifications.

MANUFACTURES:

- OLD CASTLE
- TINDALL
- STAY-RIGHT
- CAPE FEAR PRECAST
- OPEN

RESTRICTIONS: